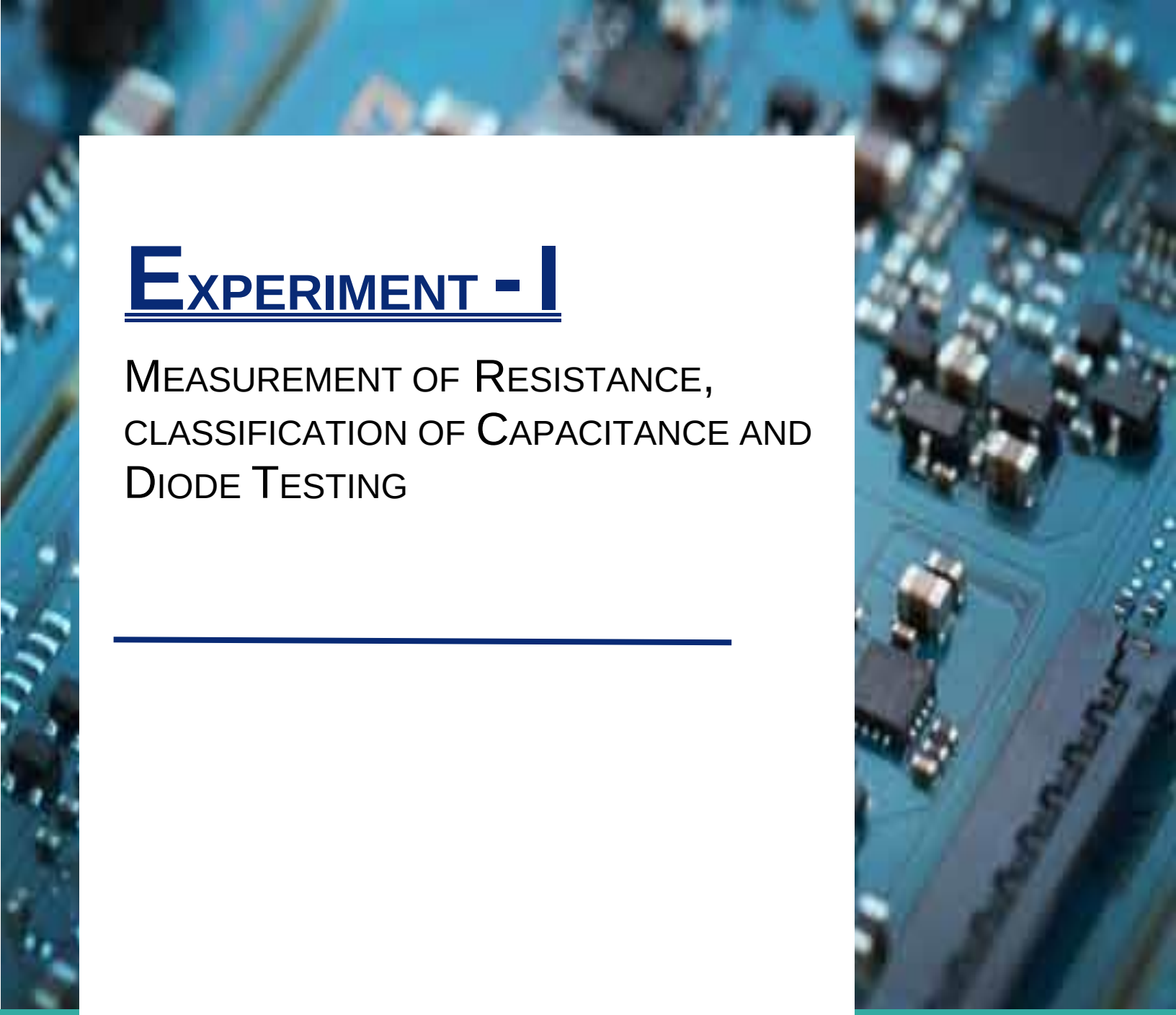


EXPERIMENT - I

MEASUREMENT OF RESISTANCE, CLASSIFICATION OF CAPACITANCE AND DIODE TESTING

AUGUST 30

Introduction to Electronics Lab (EC29003)

Report by: Sunanda Mandal

Objective : *Through this experiment, we get familiarized with passive electric components such as resistance, capacitor, inductor and diode and learn to distinguish between them.*

Part -1 (Experiment -1 on vlabs)

Aim of the Experiment:

(i) This experiment is regarding familiarization with resistors.

(ii) We will know about different types of resistors and identify.

(iii) To measure the value of a resistor.

(iv) We also study the response of a resistor to AC/DC inputs.

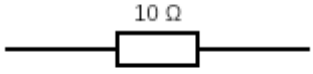
Theory:

Resistor is a two terminal passive electronic device that can conduct current in both directions.

a. **Types of resistor:**

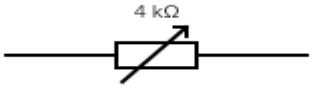
1. Fixed: The value of the component is specified and cannot be changed. (e.g. carbon film, metal film, wire wound)

   symbol:



2. Variable: The value can be changed by sliding the wiper. (e.g. semi-fixed, completely variable potentiometer)

   symbol:



b. Reading the value of fixed resistor:

A resistor is generally color coded for it is usually too small for the value to be written on it. There is usually four bands of colors, interpreted as follows:

The first color refers to the first digit of the resistance value in ohm. So as the second. The third color denotes the power of 10.

The fourth band indicates tolerance. It can also be omitted in cases.

The following table shows the code/ value corresponding to each color:

Color	Digit	Multiplier	Tolerance (%)
Black	0	10^0 (1)	
Brown	1	10^1	1
Red	2	10^2	2
Orange	3	10^3	
Yellow	4	10^4	
Green	5	10^5	0.5
Blue	6	10^6	0.25
Violet	7	10^7	0.1
Grey	8	10^8	
White	9	10^9	
Gold		10^{-1}	5
Silver		10^{-2}	10
(none)			20

c. Response:

DC:

If input voltage is V,

Current through the resistor is, $\boldsymbol{I = \frac{V}{R}}$

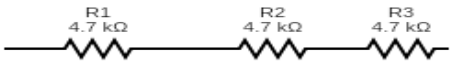
AC:

If input voltage is $\boldsymbol{V_m sin(\omega t)}$,

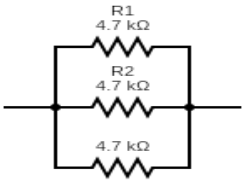
Current thourgh resistor is, $\boldsymbol{I = \frac{V_m \sin(\omega t)}{R}}$

d. **Combination of multiple resistors:**

Series: $\boldsymbol{R_{eq} = R1 + R2 + R3}$



Parallel: $\boldsymbol{\frac{1}{R_{eq}} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}}$



Discussion: Resistors are very common element present in almost every electrical circuit. Among all carbon film resistors are most widely used due the special property on carbon. It changes resistivity with pressure. So very small size of resistor can also give large resistance value.

Part -2 (Experiment -2 on vlabs)

Aim of the Experiment:

(i) This experiment is regarding familiarization with capacitors.

(ii) We will know about different types of capacitors and identify.

(iii) To measure the value of a capacitor.

(iv) We will also study the response of a capacitor to AC/DC inputs.

Theory:

Capacitor is a two terminal passive electronic device that can conduct current in both directions. It is also known as condenser. It stores energy in the form of electric field between the plates.

A capacitor is so called because it has the capacity to store charge- just like a beaker storing a liquid. Capacitors are marked with a value which indicates the capacitance, the "electrical capacity" of that body. It is measured in Farads.

a. **Construction & Types of capacitors:** Capacitors are mainly composed of two parallel metal plates with small gap in between them. Gap is filled with air or some dielectric.

UN-POLARIZED	POLARIZED
Ceramic	Electrolytic
Multilayer	Tantalum
Polystyrene Film	Super
Polyster Film	They have positive and negative electrode
Polypropylene	
Mica	
They don't have positive and negative electrode	

b. Reading the value of Capacitor: The following table briefly shows the meaning of code used on a capacitor (value measured in Farad(F)):

Third digit	Multiplier (this times the first two digits gives you the value in Pico-Farads)
0	1
1	10
2	100
3	1,000
4	10,000
5	100,000
6 not used	
7 not used	
8	.01
9	.1

Letter symbol	Tolerance of capacitor
D	+/- 0.5 pF
F	+/- 1%
G	+/- 2%
H	+/- 3%
J	+/- 5%
K	+/- 10%
M	+/- 20%
P	+100% ,-0%
Z	+80%, -20%

Generally, the capacitance of a capacitor and its power rating is written on it in value. A color code was used on polyester capacitors for many years. It is now obsolete, but of course there are many still around. The colors should be read like the resistor code, the top three color-bands giving the value in pF. Ignore the 4th band(tolerance) and 5th band (voltage rating). For example: brown, black, orange means 1000pF.

Note that there are no gaps between the color bands, so 2 identical bands will appear as a wide one.

c. Response:

A static description of the way a capacitor behaves would be to say Q=C×V, where Q is the total charge, C is a measure of how big the capacitor is and V is the voltage across it.

A dynamic description, i.e. one that changes with time would be to say I=C×dVdt. This is just the time derivative of static description .C is constant w.r.t. time, I is rate of change of charge stored, V voltage.

DC:

If input voltage is V,

Current through the capacitor at steady state is basically zero at steady state and voltage across it will be V (behaves as open-circuit).

AC:

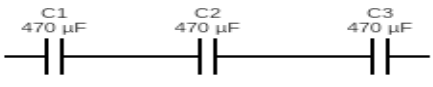
If input voltage is $\boldsymbol{V_m sin(\omega t)}$,

Current through capacitor is, $\boldsymbol{I = V_m \omega C \cos(\omega t)}$ [current leads voltage by 90 degrees] (where C is capacitance)

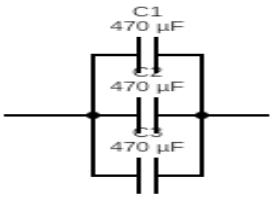
Capacitive reactance: $\aleph_c = \frac{1}{j\omega C}$

d. Combination of multiple capacitors:

Series: $1/\boldsymbol{C_{eq}} = \frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3}$



Parallel: $\boldsymbol{Ceq = C1 + C2 + C3}$



Discussion:

Capacitors are used in virtually every area of electronics, and they perform a variety of different tasks. This can be used as an electric energy storage device. Also, capacitor is used as filter, in coupling, decoupling as it allows AC to flow and blocks DC.

Part -3 (Experiment -3 on vlabs)

Aim of the Experiment:

(i) This experiment is regarding familiarization with inductors.

(ii) We will know about different types of inductors and identify.

(iii) To measure the value of an inductor.

(iv) We will also study the response of an inductor to AC/DC inputs.

Theory:

Inductor is a two terminal passive electronic device that can conduct current in both directions. Energy is stored in an inductor in the form of magnetic field energy.

a. Construction & Types of inductors:

This is mainly insulated conducting wires wound tightly around a metal core.

Inductors can be of different types depending on its core viz.

Air core

Iron core

Ferrite core

b. Reading the value of inductors:

Generally, the value of an inductor is written on itself. It is measured in H(Henry).

c. Response:

A static description of the way an inductor behaves would be to say I=infinite, I is the current through it (behaves as conducting wire).

A dynamic description, i.e. one that changes with time would be to say V=L×dIdt. L is constant w.r.t. time.

DC:

If input voltage is V,

Current through the inductor, $\boldsymbol{I}$ is basically infinite at steady state. It practically behaves as short circuited.

AC:

If input voltage is $\boldsymbol{V_m sin(\omega t)}$,

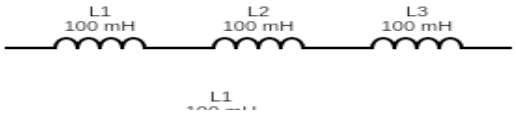
Current through inductor is, $\boldsymbol{I = -\frac{V_m \cos(\omega t)}{\omega L}}$

[voltage leads current by 90 degrees] (where L is inductance)

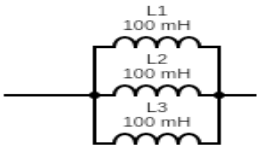
Inductive reactance: $\boldsymbol{\aleph_L = j\omega L}$.

d. Combination of multiple inductors:

Series: $\boldsymbol{L_{eq} = L1 + L2 + L3}$



Parallel: $\boldsymbol{\frac{1}{L_{eq}} = \frac{1}{L1} + \frac{1}{L2} + \frac{1}{L3}}$



Discussion:

Inductor opposes any change of circuit current. Therefore, it can be used as a valve to control flow of current through a circuit without power dissipation. Resistors can also be used as regulator but in that case power gets dissipated. It allows DC to pass and opposes AC. It is an important component of rectifier circuits.